UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY
NATIONAL DIPLOMA: FOOD AND BIOTECHNOLOGY

MODULE CET1A2E
CHEMISTRY 1 THEORY

CAMPUS **DFC**

DECEMBER EXAMINATION

DATE: **05/12/2014** **SESSION:** **08:00 – 11:00**

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PROF A MISHRA

INTERNAL MODERATOR **MS L E MACKECHNIE**

DURATION **3 HOURS** **MARKS 150**

NUMBER OF PAGES: **8 PAGES AND 1 ANNEXURE**

INSTRUCTIONS:
- **PART A AND PART B MUST BE ANSWERED IN SEPARATE EXAMINATION BOOKS, MAKE SURE YOU MARK EACH BOOK CLEARLY.**
- **GIVE ALL NUMERICAL ANSWERS TO THE CORRECT NUMBER OF SIGNIFICANT FIGURES AND WITH APPROPRIATE UNITS.**
- **CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).**

REQUIREMENTS:
- **2 x EXAMINATION BOOKS**
- **2 x MULTIPLE CHOICE ANSWER SHEET**
- **HAND IN THE QUESTION PAPER**

PHYSICAL CONSTANTS:

Avogadro's number:	$N_A = 6{,}022 \times 10^{23}$ objects mol^{-1}
Volume:	1 litre, L = 1000 mL ≡ 1 dm^3 = 1000 cm^3
Molarity:	1 *M* ≡ 1 $mol.L^{-1}$ ≡ 1 $mol.dm^{-3}$
pH :	$pH = -\log [H_3O^+]$
K_W :	$1 \times 10^{-14} = [H_3O^+][OH^-]$

A Periodic Table and a list of anions and cations are attached to this question paper.

PART A – INORGANIC CHEMISTRY

INSTRUCTIONS FOR PART A

Answer all questions in PART A in a separate answer book.

Clearly label this answer book: INORGANIC

SECTION 1 – MULTIPLE CHOICE

Answer section 1 in your answer book and clearly indicate the question number and the letter choice. For Example: 27 = E.

1. Using the solubility rules each of the following is soluble in water **except**:
A. Sodium sulphide, (Na_2S)
B. Ammonium carbonate, ($(NH_4)_2CO_3$)
C. Potassium hydroxide, (KOH)
D. Calcium carbonate, ($Ca(CO_3)_2$)

2. The correct name for $Cr_2(SO_4)_3$ is:
A. Chromium(II) sulphide
B. Chromium(III) sulphite
C. Chromium(III) sulphate
D. Chromium(II) sulphate

3. The oxidation state of chromium (Cr) in the dichromate ion ($Cr_2O_7^{2-}$) is:
A. +2
B. +6
C. +14
D. +7
E. +3

4. Precision refers to
A. how close a measured number is to other measured numbers
B. how close a measured number is to the true value
C. how close a measured number is to the calculated value
D. how close a measured number is to zero

5. The name of the binary compound N_2O_4 is
A. nitrogen oxide
B. nitrous oxide
C. nitrogen(III) oxide
D. dinitrogen tetroxide

6. How many moles of carbon atoms are there in 4 mol of dimethylsulfoxide C_2H_6SO?
A. 2
B. 6
C. 8
D. 4

7. The concentration of ions in a 0.250 M solution of HCl is
A. essentially zero.
B. 0.125 M
C. 0.250 M
D. 0.500 M

8. What are the spectator ions in the reaction between KOH (aq) and HNO_3 (aq)?
A. K^+ and NO_3^-
B. H^+ and OH^-
C. K^+ and H^+
D. H^+ and NO_3^-

9. A strong electrolyte is one that _____ completely in solution.
A. reacts
B. decomposes
C. ionizes
D. disappears

[9 x 2 = 18]

/5…

SECTION 2

QUESTION 1

1.1 Consider the reaction between calcium metal and aqueous hydrochloric acid to produce calcium chloride and hydrogen. Write the following equations for the reaction (**including physical states**):

1.1.1 the molecular equation (6)
1.1.2 the complete ionic equation and (2)
1.1.3 the net ionic equation (1)

1. 2 Show oxidation half-equations and reduction half equations for the equation in 1.1.1. (2)

1.3 The following results were obtained from replicate determination of the glucose level in patients suffering from diabetes: 61.46, 61.61, 61.55 ppm. Calculate the following parameters using the statistical mode on your calculator:

1.3.1 Mean (2)
1.3.2 Standard deviation (2)
1.3.3 Median (2)

1.4 How many millimoles of Cl^- ions are contained in 0.8891 g of $KCl.MgCl_2.6H_2O$?
[Molar mass (g mol^{-1}): $KCl.MgCl_2.6H_2O$ = 277.850] (4)

1.5 If 25.81 mL of $AgNO_3$ solution is required to precipitate all the chloride ions (Cl^-) in a 785 mg sample of $CaCl_2$ to form AgCl according to the following equation:

$$AgNO_3(aq) + CaCl_2(aq) \rightarrow 2AgCl(aq) + Ca(NO_3)_2(aq)$$

What is the molarity of the $AgNO_3$ solution? (5)

1.6 The labels on the chemical bottles sometimes fall off the chemical if stored for a long time in a chemical stock room. Suppose the label on the bottles is written 'potassium bi……' The end of the second word has been wiped out completely. You know it could be either of the two acidic salts: potassium biphthalate, $KC_8H_5O_4$ or potassium bitartrate, $KC_4H_5O_6$. One mole of each acidic salt reacts with one mole of NaOH. You find by titration that 1.021 g of the unknown acid requires 24.32 mL of 0.2060 M NaOH. What acid is in the bottle?
[Molar masses (g mol^{-1}): $KC_8H_5O_4$ = 204.221; $KC_4H_5O_6$ = 188.177] (6)

[32]

/6…

QUESTION 2

2.1 What is the molarity of K^+ in a solution that contains 63.3 ppm of $K_3Fe(CN)_6$? The solution is so dilute, the density is assumed to be 1.00 g mL^{-1}. [Molar mass (g mol^{-1}): $K_3Fe(CN)_6$ = 329.249] (5)

2.2 A 2.125 g sample of impure potassium carbonate (K_2CO_3) was dissolved in enough water to make 250.0 cm^3 of solution. A 20.00 cm^3 portion of this solution required 23.40 cm^3 of 0.09988 mol dm^{-3} hydrochloric acid (HCl) for neutralization:

$K_2CO_3(aq) + 2HCl(aq) \rightarrow 2KCl(aq) + 2H_2O(l) + CO_2(g)$

Calculate the mass per mass percent (% m/m) of potassium carbonate in the original mixture. (7)

2.3 A 25 mL sample of household cleaning solution (Handy Andy) was diluted to 200 mL in a volumetric flask. A 50 mL aliquot of this solution required 40.38 mL of 0.2506 M HCl to reach a bromocresol green end point. Calculate the % (m/v) NH_3 in the sample (Handy Andy).
[Molar mass (gmol^{-1}): NH_3 = 17.0307]

$$NH_3(aq) + HCl(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$$ (6)

2.4 A 3.00 g sample of ammonia is mixed with 6.00 g of oxygen to form nitrogen monoxide and water vapour.

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

2.4.1 Which is the limiting reactant? (5)
2.4.2 How much water is produced in this reaction? (2)
2.4.3 How much excess reactant remains after the reaction has stopped? (3)

[28]

SECTION C

ORGANIC CHEMISTRY

QUESTION 3

Fill in the missing words for the statements below.

3.1 An unsymmetrical alkene has two ___ substituents across the double bond. (2)

3.2 The common name for the rock oil is ____ (2)

3.3 During a dehydrohalogenation reaction, ____ functional group along with a ____ is removed. (2)

3.4 Cyclohexane is an example of___. (2)

3.5 The carbon atoms of ethylene can have ___ type of hybridization. (2)

3.6. Stereoisomers whose molecules are the non-superimposable mirror images, are known as____. (2)

3.7 The reaction in which hydrogen and halogen is removed from the precursor molecule is known as ___. (2)

3.8 The number of sp^2 hybridized carbon in 1,3,5 cyclohexatriene is___ (2)

3.9 Potassium permagnet is an ___ agent (2)

3.10 Heptane is the general IUPAC names given to___. (2)

[10 x 2 =20]

QUESTION 4

4.1 Draw the BOND LINE structures of the following IUPAC names

4.1.1 5-methyl-1,5-diphenyl-2-hexene (4)

4.1.2 3-isopropylhex-2-ene (4)

4.1.3 3-cyclobutyl-4-propyloctane (4)

4.1.4 2-iodo-2-methyl propane (4)

4.2 Draw the geometrical isomers of the following compounds

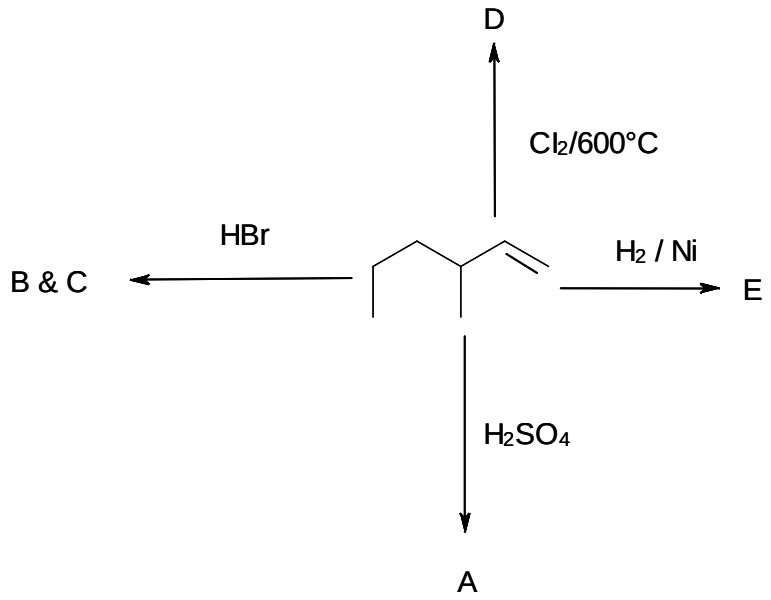
4.2.1 2,3 pentendiol (2)

4.2.2 1,2 dichloroethene (2)

[20]

QUESTION 5

Fill in the missing products marked from **A-E**.



[5 x 2 = 10]

QUESTION 6

Consider the following reaction and answer the below questions 2-iodo-2 methyl butane reacts with alcoholic potassium hydroxide to yield a major and a minor product:

6.1	Draw the structural formula for the above reaction and show the major and the minor products	(5)
6.2	What type of reaction is taking place in this example	(2)
6.3	Provide the rule which is being followed in this reaction	(3)
6.4	Show the products when the major product obtained from the above reaction reacts with potassium permanganate.	(3)
6.5	Give the IUPAC name for the product obtained from 4.4	(2)

QUESTION 7

7.1	Provide one example of hydrogenation and combustion reaction.	(4)
7.2	Differentiate between covalent and ionic bond with one example.	(6)

[10]

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Department of Chemical Technology
Atomic Number
2
He
4.0026
Atomic Weight
1 H 1.0079
3 Li 6.941
4 Be 9.0122
11 Na 22.990
12 Mg 24.305
19 K 39.098
20 Ca 40.078
37 Rb 85.47
38 Sr 87.62
55 Cs 132.91
56 Ba 137.33
87 Fr (223)
88 Ra 226.03
21 Sc 44.956
22 Ti 47.88
23 V 50.942
24 Cr 51.996
25 Mn 54.938
26 Fe 55.847
27 Co 58.933
28 Ni 58.69
29 Cu 63.546
30 Zn 65.39
39 Y 88.906
40 Zr 91.224
41 Nb 92.906
42 Mo 95.94
43 Tc (98)
44 Ru 101.07
45 Rh 102.91
46 Pd 106.42
47 Ag 107.87
48 Cd 112.41
57 La 138.91
72 Hf 178.49
73 Ta 180.95
74 W 183.85
75 Re 186.2
76 Os 190.2
77 Ir 192.22
78 Pt 195.08
79 Au 196.97
80 Hg 200.59
89 Ac 227.03
5 B 10.811
6 C 12.011
7 N 14.007
8 O 15.999
9 F 18.998
13 Al 26.982
14 Si 28.086
15 P 30.974
16 S 32.064
17 Cl 35.453
31 Ga 69.723
32 Ge 72.61
33 As 74.922
34 Se 78.96
35 Br 79.904
49 In 114.82
50 Sn 118.71
51 Sb 121.75
52 Te 127.60
53 I 126.90
81 Tl 204.38
82 Pb 207.2
83 Bi 208.98
84 Po (209)
85 At (210)
2 He 4.0026
10 Ne 20.179
18 Ar 39.948
36 Kr 83.80
54 Xe 131.29
86 Rn (222)
58 Ce 140.12
59 Pr 140.91
60 Nd 144.24
61 Pm 146.92
62 Sm 150.36
63 Eu 151.97
64 Gd 157.25
65 Tb 158.93
66 Dy 162.50
67 Ho 164.93
68 Er 167.26
69 Tm 168.93
70 Yb 173.04
71 Lu 174.97
90 Th 232.04
91 Pa 231.04
92 U 238.03
93 Np 237.05
94 Pu (244)
95 Am (234)
96 Cm (247)
97 Bk 247
98 Cf (251)
99 Es (252)
100 Fm (257)
101 Md (258)
102 No (259)
103 Lr (260)